

This key should allow you to understand why you choose the option you did (beyond just getting a question right or wrong). More instructions on how to use this key can be found [here](#).

If you have a suggestion to make the keys better, please fill out the short survey [here](#).

Note: This key is auto-generated and may contain issues and/or errors. The keys are reviewed after each exam to ensure grading is done accurately. If there are issues (like duplicate options), they are noted in the offline gradebook. The keys are a work-in-progress to give students as many resources to improve as possible.

1. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(8 - 4i)(-3 + 2i)$$

The solution is $-16 + 28i$, which is option A.

- A. $a \in [-18, -14]$ and $b \in [25, 37]$

* $-16 + 28i$, which is the correct option.

- B. $a \in [-38, -31]$ and $b \in [-4, -2]$

$-32 - 4i$, which corresponds to adding a minus sign in the second term.

- C. $a \in [-38, -31]$ and $b \in [3, 5]$

$-32 + 4i$, which corresponds to adding a minus sign in the first term.

- D. $a \in [-18, -14]$ and $b \in [-31, -23]$

$-16 - 28i$, which corresponds to adding a minus sign in both terms.

- E. $a \in [-26, -17]$ and $b \in [-9, -6]$

$-24 - 8i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

2. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{2145}{11}}$$

The solution is Irrational, which is option C.

- A. Rational

These are numbers that can be written as fraction of Integers (e.g., $-2/3$)

- B. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

- C. Irrational

* This is the correct option!

- D. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

E. Integer

These are the negative and positive counting numbers (... , -3, -2, -1, 0, 1, 2, 3, ...)

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $\sqrt{195}$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

3. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(5 - 4i)(-2 - 7i)$$

The solution is $-38 - 27i$, which is option E.

- A. $a \in [-10, -5]$ and $b \in [27.12, 28.4]$

$-10 + 28i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

- B. $a \in [17, 23]$ and $b \in [41.94, 43.43]$

$18 + 43i$, which corresponds to adding a minus sign in the second term.

- C. $a \in [17, 23]$ and $b \in [-45.09, -41.71]$

$18 - 43i$, which corresponds to adding a minus sign in the first term.

- D. $a \in [-40, -37]$ and $b \in [26.67, 27.02]$

$-38 + 27i$, which corresponds to adding a minus sign in both terms.

- E. $a \in [-40, -37]$ and $b \in [-28.56, -26.7]$

* $-38 - 27i$, which is the correct option.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

4. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{63 - 55i}{4 - 6i}$$

The solution is $11.19 + 3.04i$, which is option D.

- A. $a \in [14.5, 16.5]$ and $b \in [8.5, 10]$

$15.75 + 9.17i$, which corresponds to just dividing the first term by the first term and the second by the second.

- B. $a \in [-2, -1]$ and $b \in [-13.5, -11]$

$-1.50 - 11.50i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

- C. $a \in [10, 11.5]$ and $b \in [157, 158.5]$

$11.19 + 158.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

D. $a \in [10, 11.5]$ and $b \in [1.5, 4.5]$

* $11.19 + 3.04i$, which is the correct option.

E. $a \in [581.5, 582.5]$ and $b \in [1.5, 4.5]$

$582.00 + 3.04i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

5. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{-27 - 11i}{5 + 8i}$$

The solution is $-2.51 + 1.81i$, which is option B.

A. $a \in [-6, -5]$ and $b \in [-2, 0]$

$-5.40 - 1.38i$, which corresponds to just dividing the first term by the first term and the second by the second.

B. $a \in [-3, -1]$ and $b \in [0, 2.5]$

* $-2.51 + 1.81i$, which is the correct option.

C. $a \in [-1.5, 0]$ and $b \in [-4, -2]$

$-0.53 - 3.04i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

D. $a \in [-224, -222]$ and $b \in [0, 2.5]$

$-223.00 + 1.81i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

E. $a \in [-3, -1]$ and $b \in [160, 161.5]$

$-2.51 + 161.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

6. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\frac{\sqrt{119}}{9} + \sqrt{-6}i$$

The solution is Irrational, which is option E.

A. Nonreal Complex

This is a Complex number ($a + bi$) that is not Real (has i as part of the number).

B. Rational

These are numbers that can be written as fraction of Integers (e.g., $-2/3 + 5$)

C. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

D. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

E. Irrational

* This is the correct option!

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

7. Simplify the expression below and choose the interval the simplification is contained within.

$$13 - 17 \div 14 * 19 - (7 * 12)$$

The solution is -94.071 , which is option D.

A. $[-205.86, -201.86]$

-204.857 , which corresponds to not distributing a negative correctly.

B. $[-76.06, -68.06]$

-71.064 , which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

C. $[94.94, 98.94]$

96.936 , which corresponds to not distributing addition and subtraction correctly.

D. $[-100.07, -90.07]$

* -94.071 , which is the correct option.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

8. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{15}{0}}$$

The solution is Not a Real number, which is option E.

A. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

B. Rational

These are numbers that can be written as fraction of Integers (e.g., $-2/3$)

C. Irrational

These cannot be written as a fraction of Integers.

D. Integer

These are the negative and positive counting numbers (... , -3, -2, -1, 0, 1, 2, 3, ...)

E. Not a Real number

* This is the correct option!

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $\sqrt{\frac{15}{0}}$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

9. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{-2730}{14}} + \sqrt{0}i$$

The solution is Pure Imaginary, which is option B.

A. Nonreal Complex

This is a Complex number ($a + bi$) that is not Real (has i as part of the number).

B. Pure Imaginary

* This is the correct option!

C. Rational

These are numbers that can be written as fraction of Integers (e.g., $-2/3 + 5$)

D. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

E. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

10. Simplify the expression below and choose the interval the simplification is contained within.

$$12 - 7^2 + 4 \div 10 * 16 \div 2$$

The solution is -33.800 , which is option D.

A. $[55.01, 63.01]$

61.013, which corresponds to two Order of Operations errors.

B. $[-38.99, -33.99]$

-36.987, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

C. $[63.2, 68.2]$

64.200, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

D. $[-35.8, -29.8]$

* -33.800, this is the correct option

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.
